complex folds of enamel, leaving insular patches on the worn crown: enamel thin. The *lower molars*, long, straight, and compressed; divided by an external longitudinal indent into two unequal lobes, both penetrated at the inner side by a fold of enamel, which is complex in the hinder lobe. All the teeth have exserted crowns of equal height and arranged in an unbroken series. The bony palate is entire and extends back beyond the molars, the maxillaries and palatines forming the back part in equal proportions. A distinct articular cavity and eminence for the lower jaw; the eminence long and concave transversely, short and convex longitudinally; a protuberant post-glenoid process; a strong and deep zygoma, the orbit and temporal fossa widely intercommunicating; the premaxillaries join the nasals.

Of the genus presenting the above dental and osteal characters the author defines four species:—the first, about the size of a Llama, is the *Nesodon imbricatus*; the second, of the size of a Zebra, is the *Nesodon Sulivani*; the species to which belong the portions of skull, with the teeth, described in the present memoir, did not exceed the size of a large sheep, and is termed the *Nesodon ovinus*; fourthly, a species of the size of a Rhinoceros, *Nesodon magnus*, is satisfactorily indicated by a grinder of the upper jaw. In conclusion, the author remarks, that the osteological characters defining the orders of hoofed quadrupeds, called *Proboscidia*, *Perissodactyla* and *Artiodactyla*, are associated with modifications of the soft parts of such importance, as not only to establish the principle of that ternary division of the great natural group of *Ungulata*, but to indicate that the known modifications of the skeleton of the extinct Toxodons and Nesodons of South America, in the degree in which they differ from the osteology of the already defined orders of *Ungulata*, must have been associated with concomitant modifications of other parts of their structure which would lead to their being placed in a distinct division, equal to the *Proboscidia*; and, like that order, to be more nearly allied to the *Perissodactyla* than the *Artiodactyla*. This new division of the *Ungulata* the author proposes to call *Toxodontia*, and he remarks that its dental and osteal characters, while they illustrate the close mutual affinities between the Nesodons and Toxodons, tend to dissipate much of the obscurity supposed to involve the true affinities of the *Toxodon*, and to reconcile the conflicting opinions as to the proper position of that genus in the mammalian class.

The paper is illustrated by twenty-three highly-finished drawings, by Dinkel, of the fossil bones and teeth of the different species of *Nesodon*.

January 20, 1853.

J. P. GASSIOT, Esq., V.P. in the Chair.

The following papers were read:—

1. "On the Extension of the value of the ratio of the Circum-

ference of a circle to its Diameter." By William Rutherford, Esq., F.R.A.S. Communicated by S. Hunter Christie, Esq., Sec. R.S. &c. Received November 17, 1852.

The author, referring to a former communication on this subject, published in the Phil. Trans. 1841, states that, in the value of π there given to 208 places of decimals, there exists, in the latter part of one of the terms of the series for determining the value of $\tan^{-1}\frac{1}{99}$, a transposition of the figures of a recurring decimal, which vitiates a considerable number of the figures in the latter part of the value. This error had been detected in consequence of Professor Schumacher having observed that in the value of π which had been given him by M. Dase, who had calculated it to 200 places, from the formula $\frac{\pi}{4}=\tan^{-1}\frac{1}{2}+\tan^{-1}\frac{1}{5}+\tan^{-1}\frac{1}{8}$, the figures from the 153rd to the 200th differed entirely from those given by the author. The accuracy of M. Dase's result was confirmed by a double computation of Dr. Clausen of Dorpat, who deduced the value of π to 250 places of decimals, both by Machin's formula

$$\frac{\pi}{4}=4\tan^{-1}\frac{1}{5}-\tan^{-1}\frac{1}{239},$$

and by the formula

$$\frac{\pi}{4}=2\tan^{-1}\frac{1}{3}+\tan^{-1}\frac{1}{7};$$

and the author's result was shown to differ from the correct value by the periodic decimal $\cdot\dot{3}\dot{6}$.

Having been informed by Mr. W. Shanks of Houghton-le-Spring, that he had pushed his computation of the value of π to the extent of 318 decimals, the author resolved to extend his operations to upwards of 400 decimals. As Mr. Shanks had employed Machin's formula, the author resolved to make use of the same. At his request Mr. Shanks resumed his calculations, and has not only verified the author's value of π to 440 places of decimals, but has carried his own to the extent of 530 places. The author states that the values of $\tan^{-1}\frac{1}{5}$ and $\tan^{-1}\frac{1}{239}$, as well as the value of π, which are here subjoined, have been obtained by the independent computations of Mr. Shanks and himself, and that they both feel confident that these values are correct in every figure as far as 440 decimals.

$\tan^{-1}\frac{1}{5}=$ ·19739 55598 49880 75837 00497 65194 79029 34475 85103 78785
21015 17688 94024 10339 69978 24378 57326 97828 03728 80441
12628 11807 36913 60104 45647 98867 94239 35574 75654 95216
30327 00522 10747 00156 45015 56006 12861 85526 63325 73186
92806 64389 68061 89528 40582 59311 24251 61329 73139 93397
11323 35378 21796 08417 66483 10525 47303 96657 25650 48887
81553 09384 29057 93116 95934 19285 18063 64919 69751 94017
08560 94952 73686 73738 50840 08123 67856 15800 93298 22514
02324 66755 49211 02670 45743 78815 47483 90799 7

$\tan^{-1}\frac{1}{239}$ = ·00418 40760 02074 72386 45382 14959 28545 27410 48065 30763
19508 27019 61288 71817 78341 42289 32737 82605 81362 29094
54975 45066 64448 63756 05245 83947 89311 86505 89221 28833
09280 08462 71962 33077 33759 47634 60331 84734 14570 33198
60154 54814 80599 24498 30211 46039 12539 49527 60779 68815
58881 27339 78533 46518 04574 25481 35867 46447 51979 10232
83097 70020 64652 82763 46532 96910 48183 86543 56078 91959
14512 32220 94463 68627 66155 20831 67964 26465 74655 11032
51034 35262 82445 12693 55670 49968 44452 47904 3

π = 3·14159 26535 89793 23846 26433 83279 50288 41971 69399 37510
58209 74944 59230 78164 06286 20899 86280 34825 34211 70679
82148 08651 32823 06647 09384 46095 50582 23172 53594 08128
48111 74502 84102 70193 85211 05559 64462 29489 54930 38196
44288 10975 66593 34461 28475 64823 37867 83165 27120 19091
45648 56692 34603 48610 45432 66482 13393 60726 02491 41273
72458 70066 06315 58817 48815 20920 96282 92540 91715 36436
78925 90360 01133 05305 48820 46652 13841 46951 94151 16094
33057 27036 57595 91953 09218 61173 81932 61179 3

Commencing at the 441st decimal place, Mr. Shanks' additional figures are as follow :—

$\left(\tan^{-1}\frac{1}{5}\right)$... 78985 02007 52236 96837 96139 22783 54193 25572 23284 13846
47744 13529 09705 46512 24383 02697 56051 83775

$\left(\tan^{-1}\frac{1}{239}\right)$... 33177 28393 07086 31401 93869 51950 37058 64107 70855 85540
45223 55388 14237 67708 36515 69182 52702 00228

(π)... 31051 18548 07446 23799 62749 56735 18857 52724 89122 79381
83011 94912 98336 73362 44065 66430 86021 39488

In conclusion, the author states that Mr. Shanks has computed the value of the base of the Napierian system of logarithms as well as the values of the Napierian logarithms of 2, 3, 5 and 10, to the extent of 140 places of decimals.

2. "An Account of a Deep-sea Sounding in 7706 fathoms, in 36° 49′ South Latitude, and 37° 6′ West Longitude." By Captain Henry Mangles Denham, R.N., F.R.S. Communicated by Rear-Admiral Sir Francis Beaufort, K.C.B., F.R.S., Hydrographer. Received January 20, 1853.

This sounding was obtained on a calm day, October 30, 1852, in the course of the passage of H.M. ship Herald, from Rio de Janeiro to the Cape of Good Hope. The sounding-line was $\frac{1}{10}$th of an inch in diameter, laid into one length, and weighing, when dry, 1lb. for every hundred fathoms. Captain Denham received from Commodore M^{c}Keever of the United States Navy, commanding the Congress Frigate, a present of 15,000 fathoms of this line, 10,000 fathoms on one reel, and 5000 on another; and considers it to have been admirably adapted for the purpose for which it was made and to which it was applied. The plummet weighed 9lbs., and was 11·5 inches in length, and 1·7 inch in diameter. When 7706 fathoms had run off the reel the sea-bottom was reached. Captain Denham states that Lieut. Hutcheson and himself, in separate boats, with